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TWO MICHIGAN BEAN DISEASES

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TWO MICHIGAN BEAN DISEASES.

BY J. H. MUNCIE.

The value of the field bean crop in Michigan for the year 1913 was approximately $10,000,000.00. Any factor influencing or endangering this staple crop with its enormous investment is worthy of investigation.

HISTORY AND DISTRIBUTION OF THESE DISEASES.

Probably the most serious enemies of this crop are the two diseases Anthracnose* and Blight. These two diseases are not at all new to this state. Bean Anthracnose was first discovered in Germany in 1875. Since that time it has been reported in most of the European countries as well as extensively in the United States. Bean Blight was first recognized as a bean disease in 1892 in New York bean fields. It is found in Europe also. It seems safe to say that these bean diseases have practically the same distribution as commercial bean growing. The first authentic report of Anthracnose for Michigan was in 1889, when it ruined the crop around Lansing. The first authentic Michigan specimens of Bean Blight were collected in 1900, but the disease was probably prevalent before this time. The great interest now shown in bean diseases is the result of the tardy realization by the farmers of the damage being done to the crop. It is, however, a case of old diseases—of losses of long standing—which are new to the grower.

LOSS.

It has been estimated by various bean dealers in this state that the loss to this crop from these diseases was about $2,000,000.00 for the year 1913. This figure seems conservative when one considers the fact that in many sections the average "pick" of 1913 beans ran about eight pounds to the bushel, and in some cases as high as twenty pounds per bushel. On examination of cull beans from various sections of the state, it was found that at least 50% of the pickings was made up of diseased seed. A further loss is due to the cost of "picking" and the reduction of price paid to the farmer on account of the discolored beans.

It is difficult to say which of these diseases is the more injurious. It is well known that in areas where continued wet weather is prevalent, Anthracnose is more noticeable, especially upon the pods and seeds. Blight also is widespread under such conditions, and inflicts serious damage to the crop by its attack upon the leaves, which causes a marked reduction of the yield and uneven ripening of the pods.

*"Rust" is a common name in some sections for this disease. Since there is a true rust of beans, which however is of minor importance in Michigan, the name "Anthracnose" should be used to avoid confusion.

SIGNS OF THE DISEASES.

Bean Anthracnose and Bean Blight have generally been confused. To aid in differentiating these two diseases, the following table is given, in connection with which the colored plate should be consulted.

	Bean Anthracnose.	*Bean Blight.*
CAUSE.	A parasitic *fungus;** *Glomerella* (*Colletotrichum*) *lindemuthiana* (Sacc. & Magn.) Shear.	A parasitic *bacterial organism; Bacterium phaseoli* E. F. Smith.
SIGNS ON THE SEEDS.	In case of *light attack*, sunken black or brown specks. In case of *severe attack*, brownish or blackened spots, usually a *circular ring* with a dark or rifted center.	In case of *light attack*, yellow spots or blotches, not definitely circular; frequently on the side of the seed which was attached to the pod. In case of *severe attack*, completely *yellowed, shriveled* seed. Many of the half-matured seed grew on plants which were struck by Blight.
SIGNS ON THE SEED LEAVES.	*Starting* as sunken, *maroon-colored* circles or kidney shaped blotches, resembling spots on the pod; *These may enlarge* until the whole seed leaf is covered.	*Starting* as small *amber-colored* spots or blotches; *These may enlarge* until the entire seed leaf is discolored; or seed leaves may be smeared with a light yellow slime.
EFFECTS ON THE STEM.	*Starting* as small pin-point, circular, dark-red spots. *These enlarge* into elongated, maroon spots, or cankers, extending far up and down the stem. Young stems frequently rot a short distance above the ground. Old stems crack.	Probably causes a cankered condition of the stem, similar to that of Bean Anthracnose, but with the cankers less sharply defined.

EFFECT ON THE ROOT.

Diseased seedlings frequently show a rotting of the main root. This is doubtless caused primarily by the attack of these organisms followed by secondary rot-producers. Plants so injured lack a deep root system and are dependent wholly upon the side roots near the surface of the ground. In cases of early drought, such plants turn yellow or wilt, or may even die, thus causing bare spaces in the field. This phase of attack has never been emphasized before, but probably a part of the great superiority of clean seed over "heavy pickers" comes from the absence of this severe attack on young plants.

*A parasitic fungus is a plant which makes no food for itself but steals its living from another plant, called the host. The vegetative part of the fungous parasite, i. e., the body, consists of threads which grow either upon or within the host, absorbing the food supply from the tissues. Fungi, for the most part, spread by microscopic bodies called *spores*, which are produced in vast numbers. These bodies are either forcibly ejected a short distance and are then wafted by air currents, or are splashed about by rains. They serve the same purpose as do seeds for the higher plants.

EFFECT ON THE LEAVES.

Smaller leaves may be crinkled. This is due to the effect of the fungus upon the margin of the unfolding leaves.

On old leaves the attack of the fungus shows up *mostly on the veins.* This canker is similar to those on the stem. Frequently part of the leaf blade may be involved. Affected leaves show dark lines from above and blackened shriveled leaf veins from beneath. Parts of the leaf beyond the killed leaf vein turn yellow or die from lack of water.

The disease starts as *irregular, water-soaked* areas which are usually bordered by distinct yellow or red lines. This is very pronounced with Lima beans. These killed areas gradually increase in size until *the entire margin or half the leaflet* may be involved. The clear, watery areas dry out and become brown and brittle. Deeper colored triangular masses are scattered over these areas. These are clumps of bacteria.

EFFECT ON THE PODS.

Starting as small *maroon* pin-point spots, these enlarge rapidly, the color deepening meanwhile, usually making a *circle* but sometimes running together, thus forming a *kidney-shaped canker*, or sore.

These spots dry out and become slightly but uniformly sunken with a raised rim. In the centers of the red spots *yellow* or *pink spore-masses* about 1/50 inch in diameter are produced.

The organism in these spots sends its threads through the pod into the seed, producing the spotted seed, as described above.

Starting as small, slightly raised, *watery pustules* on the young pods, these enlarge and assume a reddish-yellow tinge.

These spots become *amber-colored*, irregular *blotches* with uneven, gnarled, green centers. In the center of the old spots are found *yellow crusts* of the bacteria which have oozed out.

The organisms in the spots, especially those along the hinge of the pods, get to the seed within, producing the *yellowed, spotted, shriveled* seed described above.

FIELD APPEARANCE.

If wet weather is abundant at planting time, the seeds may rot in the ground, or seedlings with blotched seed leaves and cankered stems come out of the ground. Young plants frequently rot and *topple over.* The main root rots off, then

If wet weather is abundant at planting time, the seeds may rot in the ground or seedlings with rotted seed leaves come out of the ground. The main root rots off, then

If Early Drought Follows Planting.

Plants become yellowed and wilted, due to the lack of a deep root system. This gives a field with bare spots and frequent blanks in the rows.

In mid-summer with continued *wet* weather,

Fields look *yellow.*

Leaves turn yellow and *drop off*, due to a stoppage of the water supply by cankers on the stems or leaf stalks.

Growth is *checked* somewhat.

Pods show spots. Rotting of pods may be very severe.

In midsummer with continued *muggy* weather,

Fields look *as if drenched with hot grease.*

Leaves show *excessive drying* and *burning.*

An *excessive amount* of *new growth* is produced to replace destroyed leaf surface. These new shoots blossom profusely and continue setting new pods.

Pods cease to fill out;

Ripening is uneven; hence many small immature beans and beans with the lining of the pod sticking to the seed coat, are present after threshing.

CONTROL MEASURES.

Pod selection. Seed Plot.

None known.

Palliative—secure as clean seed as you can.

DESCRIPTION OF PLATE.

Bean Anthracnose. Caused by Glomerella (Colletotrichum) lindemuthiana (Sacc. & Magn.) Shear.

(A) Maroon Anthracnose spot on young pod, showing spore masses of the fungus.

(B), (C), (D) Seeds spotted by Anthracnose. Note the difference in color of these spots as compared with the spots on seeds affected by Blight, (M, N & O).

(E) A pod badly distorted by Anthracnose.

(F) Note the long canker produced by the growing together of a number of single Anthracnose spots such as those on "E."

(G) Darkened veins on under side of the leaf caused by Anthracnose.

(H & I) Single disease spots containing the pink spore masses of the Anthracnose fungus.

Bean Blight. Caused by Bacterium phaesoli E. F. Smith.

(K) Irregularly outlined amber-colored spots caused by the Blight bacteria.

(L) Pod badly affected by Blight. Note the heavy spotting along the hinge of the pod.

(M), (N), (O) Seed from a blighted pod. The bacteria have worked through the pod and discolored the seed within.

(P) A blighted leaf. The dried-out, browned portion of the leaf contains the Blight bacteria.

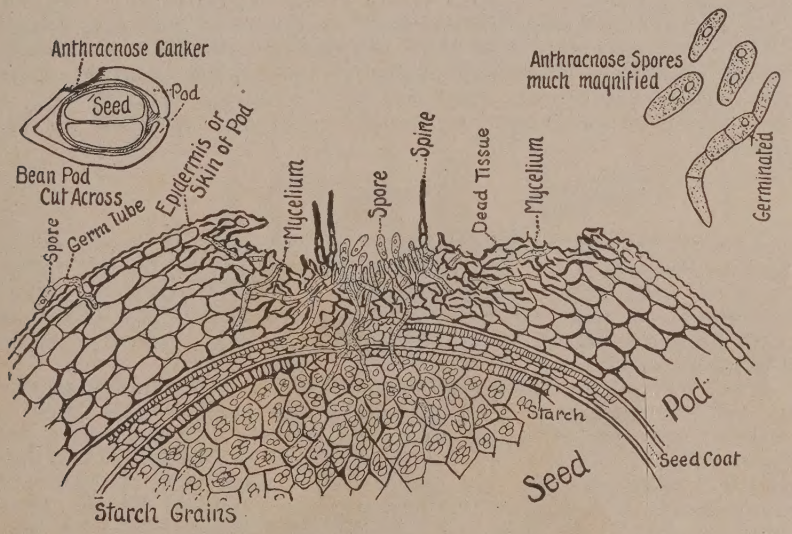
LEGEND OF PLATE.

A to I Bean Anthracnose. K to P Bean Blight.


A
B
C
D
E
F
H
I
G
K
L
M
N
O
P

BEAN ANTHRACNOSE.

Bean Anthracnose is caused by a parasitic fungus, *Glomerella* (*Colletotrichum*) *lindemuthiana* (Sacc. & Magn.) Shear. The fungus, carried to the field in the affected seed, comes above the surface of the ground upon the young seedlings, and spreads to the leaves and stalks of the



The small figure to the left above, shows a diagrammatic section of a bean pod through an Anthracnose canker.

The large drawing is a much enlarged view of the above figure, showing the fungous threads penetrating the pod and growing into the seed. These threads penetrating the seed produce the brown or black spots. These threads remain dormant from harvest time until the seeds are planted when they begin to grow, producing cankers on the seed leaves. The spores in the canker are exposed thus insuring their spread by rain, dew or mechanical agents to other plants.

The figure to the right above, shows spores of the Anthracnose fungus. One has germinated. (H. H. Whetzel, Cornell Agr. Exp. Sta. Bul. No. 239.)

plant, either by the direct wiping of the spores on the growing shoot or by the spores being washed down from the seed leaves to the stem. Spotted pods are caused by spores from the leaves being washed to them by rain or dew or wiped upon them by the swaying plants brushing each other. Cultivation of, or walking through bean fields, when they are wet, results in the spread of the disease. Insects may carry the disease, but definite observations upon this have not been made. The fungus finally penetrates the pod to the seed within, producing a spot upon it. This spotting of the seed causes by far the greatest loss due

to Anthracnose. However, only seeds into which the fungus has penetrated deeply and excessively show these spots. If the penetration is but slight, the seed may remain white; hence, the impossibility of securing disease-free seed by hand-picking.

RELATION TO THE WEATHER.

Bean Anthracnose requires continued wet weather, threatening weather or long periods of heavy dew to work its greatest injury to the crop. Moisture is necessary for spore formation and germination, as well as for the spread of the spores to the stalks, leaves, and pods of surrounding plants. Since the spores of the fungus causing this disease ooze out in masses and are held together by a kind of mucilage which dries down to a hard crust, moisture is necessary to soak these spores apart, and allow their spread by mechanical agencies. Once Anthracnose has become established in a locality, it requires only a few seasons of continued wet weather to produce epidemics of this disease.

CONTROL.

Although spraying with Bordeaux mixture was formerly recommended by Prof. Halsted of the New Jersey Experiment Station for the control of Bean Anthracnose, the experiments of Prof. Whetzel of Cornell University and those by the Department of Botany of this station in 1913, showed little control of the disease. At best spraying is yet in the experimental stage.

Prof. Whetzel has found that Anthracnose can be absolutely avoided by securing seed from clean pods. The selected pods must have no diseased spots whatever upon them, and must be kept away from diseased pods. These clean pods may be dipped for ten minutes in corrosive sublimate solution (one part to one thousand parts of water), to make doubly sure of avoiding contamination. Dry in the sun away from the dust of the bean field. Shell so that the dust from the bean fields or from other beans will not get to the shelled seed.* Seal this seed in air-tight Mason Jars.** This seed should be used to plant a seed plot which should be on clean ground. The crop from this seed should be free from Anthracnose and largely free from Blight and if kept from contamination, should give extremely desirable seed for next year. On a small plot of this kind, any diseased plants may be easily detected and pulled out and burned. This is a wholesome sanitary measure. Such pod selection has been practiced in Michigan by a few growers and with excellent success and, in the one

*It is safe to say that if clean beans are threshed by a machine through which blighted beans have been run, or are placed in old bean sacks or flailed on dusty barn floors, they will probably become contaminated by the Blight and even by Anthracnose.

**If weevils threaten the beans, Dr. Edgerton of the Louisiana Experiment Station advocates fumigation with carbon bisulphid. The beans are placed in an air-tight box or barrel and the carbon bisulphid placed in an open dish on top of them. About nine or ten ounces of carbon bisulphid should be used for each hundred cubic feet of space. After the bisulphid is placed in the barrel or box, put the cover on tightly and cover with a heavy blanket. Fumigate from twenty-four to thirty hours. After this length of time, take off the cover to allow the fumes to escape. This fumigation must be carried on away from all lights or fire on account of the explosive nature of the vapor. The beans will thus be kept free from weevils until ready for planting.

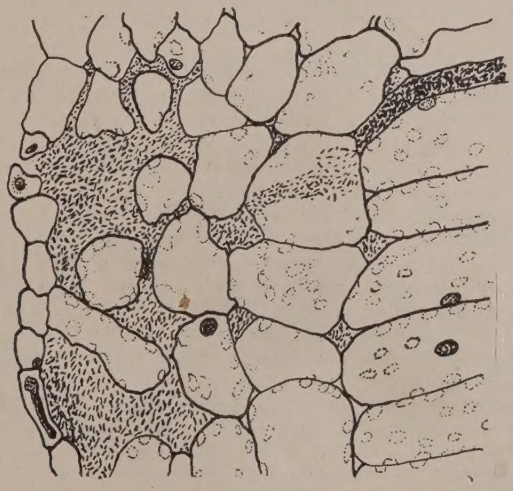
case carefully examined, the seed* from the general crop, while not absolutely disease free, *contained not a single bean that would have been taken out in ordinary commercial hand picking.*

A CONFUSING CONDITION.

Although the method above given is known to eliminate Anthracnose, it will not entirely control Bean Blight. The reason for this is given later in the discussion of that disease.

BEAN BLIGHT.

The disease, Bean Blight, is caused by one of the bacteria, *Bacterium phaseoli* E. F. Smith, which, so far as is known, attacks only varieties of beans and lupines. The disease germs are carried over from one



Section through a blighted bean leaf showing the bacteria within the leaf tissue. (Redrawn from E. F. Smith. Bacteria in Relation to Plant Diseases. Vol. 2, 1911.)

season to the next on and in the affected seeds, and upon the contaminated seeds; in all probability they also live over on diseased pods and trash, experiments at the Louisiana Experiment Station having shown that the germs are able to resist drying for more than two hundred days. No doubt the germs washed from the affected leaves and pods to the ground, dry and are disseminated by the wind.

*In examination of a sample of beans from this crop in which seed selection and roguing had been practiced by the grower, only fourteen and six-tenths percent of discolored seeds was found. This seed had never been hand-picked and none of these discolored seeds would have been picked out in ordinary commercial hand-picking. In a sample of ordinary marketable beans, *which had been hand picked,* thirteen and six-tenths percent of the seeds was similarly discolored.

WHY POD SELECTION DOES NOT WHOLLY CONTROL BLIGHT.

The bacterium causing Bean Blight is much smaller than the spores of the fungus causing Bean Anthracnose. Moreover, as in the case of pods and seeds, the Anthracnose fungus frequently has produced no spores but is present as deep-seated fungous threads. It is therefore much easier to avoid this fungus with its larger fruiting bodies, which is deep-rooted in the tissue, than the disease caused by the minute, easily dislodged bacteria, any one of which is capable of starting the disease anew. The Blight bacteria, furthermore, are undoubtedly present in the bean dust and trash from the fields, so that pods free from Anthracnose are usually not free from contamination by Blight germs, even when they are not spotted. The practice of pod disinfection here advocated for the first time would destroy the externally adhering germs. Being a surface disinfection, it cannot be counted upon to destroy the organisms of the diseases *within* the tissues of the pod or seed.

WHAT IS GOOD SEED?

Too much importance cannot be attached to the securing of clean seed for planting. Aside from the relative freedom from disease of such seed, good seed is a sound business proposition. High grade seed will more than make up in the more perfect stand, in the uniformity of ripening and in the increased yield for its extra cost. This seed should have the following qualities:

1. A comparatively low per cent of seed showing even a slight discoloration. The Department of Botany will determine, free of charge, this spring, the percentage of disease-discolored seed and send the grower a report upon the findings in each sample. The sample sent for this purpose should be at least a half pint in quantity and should be marked with the name and address of the sender. An accompanying letter should give the name of the grower, locality where grown, and if hand picked, the "pick" per bushel.

2. Good yielding qualities. The dealer should be able to give you the record of any variety of seed beans which you may purchase.

RECOMMENDATIONS FOR THIS YEAR'S PLANTING.

1. Get as high-grade, clean seed as you can from reliable dealers. If you buy from sample only, see to it that the stock you buy is the same as the sample.

*2. "Northern grown" or imported seed is no better than a strict examination for discoloration would indicate. If it is seed from a locality which suffered from Blight and Anthracnose last season, it is

*This recommendation is made wholly in light of the bean disease problem and does not touch upon points of quality, size, hardiness, etc., claimed for northern-grown seed. It is worthy of note that the best yields of beans of the most desirable type (small pea-beans) of all the varieties tested at the Experiment Station were obtained from seed bred there for several generations by F. A. Spragg of the Farm Crops Department, and not from "northern grown" or "imported" seed.

apt to be no better than home-grown seed in its freedom from these two diseases. Do not buy seed relying simply on the much abused terms, "northern grown," "western," etc., but seek clean, desirable seed.

3. All seed should be hand picked. Two pickings are better than one. No seed showing the slightest discoloration should be planted. Never plant "cull" beans, or even the general run. Such seed, beside being a prolific source of disease, comes up unevenly and gives a poor stand of beans of inferior quality.

4. Practice crop rotation in raising beans. Aside from the necessity of this in the maintenance of soil fertility, crop rotation is beneficial as a sanitary measure, and helps greatly to avoid disease epidemics.

5. While no experimental evidence is at hand now, to show that manure from stock fed on bean fodder and pods carries the diseases to the fields, many farmers report serious losses on fields fertilized the previous fall with such manure. It is a matter of precaution to avoid planting beans immediately on ground so manured.

6. Do not cultivate or walk through a bean field while the plants are wet with dew or rain. To do so is to spread disease from one part of the field to another.

7. Plan to put into practice the control measures outlined on page 7.

THE BEAN DISEASE SITUATION.

Michigan bean growers are becoming aware that the two diseases, Anthracnose and Blight, long known and long destructive in this state, are causing a serious money loss each year.

These diseases are not only present in Michigan but also in all states where beans are grown commercially, and the loss in each, varying with the weather conditions, is practically similar to Michigan's loss.

There is absolutely no basis for discrimination against Michigan beans on account of these diseases.

A workable control measure is known for Anthracnose, but at present no one knows how to control Blight.

To stimulate interest in this problem, and to furnish the grower with first-hand knowledge of the conditions, this popular bulletin has been prepared. All concerned must feel the necessity of planting as good seed as possible and all should be alert for possibilities for improvement.

Since the bacteria of Blight are largely adhering to the outside of the seeds, seed disinfection would seem to be a promising method of treatment. Although such treatments have been experimented with to some extent, so far none has been found which is worthy of recommendation. A part of the experimental work of the Department of Botany is therefore being directed toward treatments of bean seeds for the control of this disease as well as Anthracnose.

The growing of varieties of beans resistant to Anthracnose has been investigated by Dr. M. F. Barrus of Cornell University. He found that while a race of beans might be comparatively resistant to the Anthracnose fungus found in one locality, it might also be very susceptible to the Anthracnose fungus from another locality. This

would seem to indicate that resistance to Anthracnose as developed in any plants might be more or less local. The discovery and propagation of Blight-resistant plants is strongly to be urged. Occasionally in blighted fields some plants of desirable yielding qualities show marked Blight resistance. Judging from the signal successes with other plants, such as watermelon, cabbage, potato, etc., it would seem that the careful selection and multiplication of such resistant plants would lead to the development of very desirable strains. It is worthy of note that in all these cases of successful breeding of disease-resistant plants, success was attained only when the work was done in a locality where the disease was very prevalent. It seems, therefore, reasonable to suppose that such efforts in the case of bean diseases should be undertaken with local strains as these will already have attained, by natural selection, a certain degree of resistance, while seed from regions rather free from disease possess this power of resistance to a far less degree. The success of Mr. F. A. Spragg of the Farm Crops Department of the Experiment Station, in growing a semi-resistant strain and improving the quality and yield of seed without recourse to northern-grown stock, would indicate that much may be hoped from work with strains all ready partially adapted to the local conditions. Indeed, it may be questioned to what extent it is advisable to attempt the general importation of seed from disease-free regions into a badly infested locality on account of the greater susceptibility of such strains to the local diseases. In cooperation with the Department of Farm Crops, the matter of resistant varieties will be vigorously followed up in the college fields. It is an open problem, however, for all bean growers interested in the development of a desirable bean for the seed trade.

Seed from practically every county in Michigan, and from every state thought to raise desirable seed, is being examined to determine the prevalence of these diseases. Seed worthy of trial will be planted this spring in at least ten counties of the State. It is hoped that from these experiments, the value of seed importation can be determined.

The Department of Botany believes that the great loss from these diseases may be a preventable one. While no promises can be made as to the outcome of the work, the Department is seeking by painstaking investigation to try out such control measures as are suggested by our knowledge of the organisms which cause the diseases.